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Observations of Mars made at Mr. Crossley's Observatory, Bermerside, Halifax, during the Opposition 1898–9. By J. Gledhill.

I.

Notes on the Markings Seen on the Disc.

The following observations of *Mars* were made with the 9-inch Cooke Equatorial Refractor (the new triple object glass). The powers used were 240 and 330; the former as that most generally useful, the latter on the very few exceptionally good nights. The planet was carefully examined—indeed, watched almost continuously, often for several hours—on every clear night from 1898 December 19 to the end of March 1899, in all some forty nights. The definition was never continuously good, and the seeing and identification of the features often called for much patient gazing. The limb and the terminator were on every occasion most carefully examined for irregularities of form. No such were ever surely seen except on one night, the one occasion when the perfect stillness of the planet allowed of the use of powers 330 and 470. The southern edge of the N. polar ice-cap was often examined, but no trace of any breaks or projections was ever seen. To a very large extent, no doubt, these failures were simply a measure of the bad observing conditions experienced here during the winter. The projection seen for more than an hour on 1899 January 24 would certainly have escaped detection on an average night owing to the undulations on the limb.

1898 December 19, 11^h to 12^h, λ, the longitude of the central meridian, $=295°$ to $310°$. Bad definition, *p* limb very bright, the bright lune extending inwards up to the Kaiser Sea; *f* limb dull; the N. polar ice-cap large and white. The dusky Delambre Sea extends from the S. edge of the ice-cap nearly to the N. point of the Kaiser Sea. All the region to the east of the Kaiser Sea (between it and the *f* limb) was of a warm tinge.

1898 December 20, 11^h to 12^h, $\lambda=286°$ to $301°$. There was a bright region about the S. pole of the disc—probably Lockyer Land. It was bright and of a pale yellow tint. As always, the N. portion of the Kaiser Sea was the darkest portion of that feature, and also perhaps one of the darkest parts of the disc. There was a little warm colour in the region *p*, the Kaiser Sea (Herschel I. Continent), and a deeper tint in the region following it (Beer Continent). The bright lune at *p* limb was much narrower than on the 19th. Delambre Sea was seen, but not well.

1898 December 22, 11^h, $\lambda=268°$. Lockyer Land, the Kaiser Sea, the grey space between the two, Delambre Sea and the coloured continents of Herschel I. and Beer, were seen as on the 20th.

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The *p* and *f* limbs differed very little in brightness : the colour did not run quite up to the *p* limb as it did to the *f* limb. The bright lune on the *p* limb was narrow. At 12^h, $\lambda=283°$, the Kaiser Sea was about central. The dark fringe on the S. edge of the N. ice-cap was seen, but not clearly. The *p* limb was perhaps not quite so bright as the *f* limb. At 13^h, $\lambda=297°$, the Delambre Sea was better seen. Lockyer Land was bright. At 14^h Nasmyth Inlet and Laplace Land were seen, as well as Herschel Strait and Phillips Island.

1898 December 24, 11^h, $\lambda=250°$. The Kaiser Sea was not far from the *f* limb ; the deepest colour lay to the west of it (Herschel I. Continent), a paler tint between it and the *f* limb. The *p* limb was thought to be less bright than the *f* limb. A faint marking was seen on Herschel I. Continent a little to the E. and S. of Fontana Land. Delambre Sea was seen.

1898 December 27, 12^h, $\lambda=238°$. Again the *f* limb was thought brighter than the *p*. All other features as on the 24th.

1899 January 4, 11^h, $\lambda=153°$. The only feature seen in the N. portion of the disc was Oudeman Sea. The bright region round the S. pole of the disc was probably Webb Land. Of the E. and W. limbs the *p* was the brighter. Of course Maraldi Sea was seen, but the definition was not good enough to show Trouvelot Bay and Noble Cape.

1899 January 11, 8^h, $\lambda=48°$. With the exception of the grey band about the S. pole of the disc (the De Tottingnez Sea &c.) the only marking seen was Airy Sea with a portion of Campani Sea to the N. of it. The bright lune of the *p* limb was wide.

1899 January 13, 7^h, $\lambda=16°$. Knobel Sea, the bright Mädler Continent, the grey De la Rue Ocean and the bright Jacob Land near the S. edge of the disc were well seen. The bright lune of the *p* limb was very bright and extended far inwards, say one fifth or one-sixth of the radius of Mars. There was also a considerable brightening of the warm-toned area to the east of the central meridian and near the *f* limb. That portion of Campani Sea just N. of Knobel Sea was darker than the latter, and it was in contact with the ice-cap. Burton Bay was seen.

1899 January 19, 7^h, $\lambda=323°$. The Kaiser Sea was not far from the *p* limb ; there was no warm colour between it and that limb. There was a faint warm tinge along the *f* limb, and the bright lune on the *p* limb was a well-marked feature. Dawes Forked Bay was seen, but not Burton Bay. Delambre Sea lay along the S. edge of the ice-cap and was darkest opposite the Kaiser Sea. At 8^h the Kaiser Sea was much fainter, being near the *p* limb. The darkest feature of the disc was Herschel II. Strait and the two forks. Phillips Land, Arago Strait, Knobel Sea, Kunowski Land, and Jacob Land were seen at 9^h. The Kaiser Sea remained faintly visible when it seemed (*i.e.* the eastern boundary of it) but a line close to the *p* limb. Nasmyth

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Inlet and Lassell Sea were never seen except when the observing conditions were good.

1899 January 24, 7^h, $\lambda = 280°$. The Kaiser Sea was near the central meridian. Delambre Sea was seen. A small bright roughly circular spot was seen close to the western side of the Kaiser Sea near where the equator of Mars cut it. Soft warm colour overspread all the region E. and W. of the Kaiser Sea. The width of the bright lune on the *p* limb was about one-fifth of the radius of the planet. At 9^h Nasmyth Inlet and Lassell Sea were seen: of these two features the portions best seen on all occasions are the hump of the former near the N. point of the Kaiser Sea, and the whole of the southern projection called Lassell Sea. Dawes Forked Bay and Phillips Land were seen.

1899 January 25, 7^h, $\lambda = 271°$. The bright lune at the *p* limb, the much less bright terminator, the Kaiser Sea and the ice-cap, all as on the 24th. The Kaiser Sea was central about 8^h. At $8\frac{1}{2}^h$ Lassell Sea was seen occasionally. Dawes Forked Bay was seen, faint and near *f* limb: the two forks or inlets seen as one—*i.e.* definition was not good enough to separate them. Up to 12^h the definition was very poor. Projections &c. on limb and terminator were carefully looked for.

1899 January 31, 10^h. The Kaiser Sea was near the central meridian; the warm colour was deeper to the W. than to the E. of it. Very cloudy night.

1899 February 1, 7^h, $\lambda = 209°$. Oudeman Sea was about central; close to its eastern or *f* side was the bright circular region called Fontana Land. The eastern edge of Oudeman Sea was darker than the western. At the first glance this sea might be mistaken for the Kaiser Sea: its shape was triangular with the point downwards, *i.e.* to the N. This northern-pointed portion did not appear to be connected with Schröter Sea to the N. of it. The *p* limb was very bright; the terminator very much less bright.

At $8\frac{1}{2}^h$ Delambre Sea was seen near the *f* limb and resting on the ice-cap. At 9^h the Kaiser Sea lay close to the *f* limb, faint, but easily seen; it was of about the same grey tone as the seas about the S. pole of the disc. At 10^h Webb Land and Burckhardt Land were seen as one continuous broad light-coloured region, *i.e.* the narrow portion named Niesten Isthmus was not noticed.

1899 February 14, 5^h. Airy Sea was not far from the *p* limb: it appeared as a dusky region resting on the S. edge of the ice-cap (N.), and a dusky wisp or two were seen in the central portion of the disc. The S. polar region was bright. At 7^h a portion of De la Rue Ocean was near the *p* limb and was the darkest marking of the disc. A very slight dusky fringe lay along the S. edge of the ice-cap: the *p* limb very bright: the terminator dull. This S. edge has been very carefully examined on every fine night, but no projections or irregularities in the curve were seen.

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1899 February 16, 7^h, $\lambda=76°$. Airy Sea faint; Campani Sea, to the N. of it, was the darkest feature of the disc. A faint dusky sweep was seen to the S.E. of Airy Sea: it was probably the faint grey region separating the Mädler and Secchi Continents in Green's map. Christie Bay was of course well seen.

1899 February 17, 6^h, $\lambda=52°$. Campani Sea was the darkest marking of the disc; it was very dark. Airy Sea was not so dark, its southern portion being still less dark and extending southwards to the equator of the disc. Christie Bay was dark, and the dusky sweep to the S.E. of Airy Sea was again seen. At 7^h and 8^h Jacob Land was bright and coloured like Secchi Continent.

1899 February 21, 7^h, $\lambda=31°$. The southern boundary of the Polar cap was a dark fine line: on it lay a dark form, Knobel Sea, very dark in its northern portion and growing fainter to the South. A faint sweep of grey was seen to the N.E. of Knobel Sea at the eastern end of Mädler Continent. The preceding end of the broad band (De la Rue Ocean &c.) seemed to stop short suddenly a good way from the *p* limb, while at the terminator this same broad grey band extended quite up to the edge of the visible disc. De la Rue Ocean was not nearly so dark as the Northern part of Knobel Sea and the Campani Sea to the north of that.

1899 February 22, 7^h to 9^h. Knobel Sea, the bright division between it and Campani Sea, Campani Sea, Christie Bay, all seen as on the 21st. The bright Rosse Land was not seen. Hall Land probably seen: *i.e.* a small bright region was seen not far from the S. pole of the disc, which was probably Hall Land.

1899 February 23. Looked carefully for the bright region (see Green's map) called Rosse Land, but did not see it. The three bays, Dawes Forked Bay and Burton Bay, were well seen.

1899 February 24, 7^h to 9^h. The regions seen were the three bays (Dawes and Burton), Knobel Sea, Leverrier Land, Lassell Sea, Phillips Island, Arago Strait, Jacob Land, Hall Island, and the Kaiser Sea.

1899 February 25, 7^h to 8^h. The Kaiser Sea lay near the *p* limb; it became gradually fainter as it neared the limb, and at last broke the bright line of the limb, *i.e.* the very bright line of the limb was less bright at that part than to the north and south of it. Knobel Sea, Leverrier Land, Lassell Sea, Nasmyth Inlet, the three bays, Phillips Land, and Laplace Land were seen. A bright spot was noticed near where Proctor Cape is marked on Green's map. The fringe along the south edge of the polar cap was faint and narrow.

1899 February 26, 7^h to 9^h. The Kaiser Sea was again watched as it approached the bright lune of the *p* limb, and again that portion of the lune was dimmed. The bright Rosse

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Land was looked for but was not seen. All the features seen on the 25th were again easily seen. Lassell Sea could be seen continuously. Nasmyth Inlet was seen now and then for a moment: it was darker but smaller than Lassell Sea. Or, it may be said, that the fainter broad inlet between the N. end of Lassell Sea and the N. end of the Kaiser Sea was seen with some difficulty; while the dark protuberance at the *p* end of the inlet was much more easily seen.

1899 February 27, 7^{h}. The Kaiser Sea, the three bays, Nasmyth Inlet, Lassell Sea, and Knobel Sea, were seen. It was not a good night.

1899 March 1, 7^{h} to 12^{h}. The phenomena attending the approach of the Kaiser Sea to the *p* limb were seen as on February 26. The long narrow Nasmyth Inlet and Lassell Sea were steadily seen, also Lockyer Land, Phillips Land, Knobel Sea, and the three bays. Lassell Sea and the protuberance at the *p* end of Nasmyth Inlet were much darker than the intermediate portion (*i.e.* the portion over which stands the name Nasmyth Inlet in Green's map). The same remarks as to objects seen &c. apply to March 2, 7^{h} to 10^{h}.

1899 March 2, 9^{h}. The Kaiser Sea was near the *p* limb, Knobel Sea near the terminator. The Forked Bays, Delambre Sea, and the bright Phillips Land were seen and identified. When the Kaiser Sea reached the bright lune on the *p* limb, the latter was shorn of much of its brightness. At 7^{h} Lassell Sea and Nasmyth Inlet were seen.

1899 March 15, 7^{h} to 8^{h}. Good definition: power 330: some mist. The features seen may be described thus:—A small bright region round the S. pole of the disc, probably Webb Land; the broad, greenish grey band extending from limb to terminator, *i.e.* Maraldi Sea, &c. &c., and which extended quite up to the terminator but became very faint near the *p* limb; the broad (one-fifth to one-fourth of the radius) bright lune along the *p* limb: a dusky form or feature not unlike the Kaiser Sea, *i.e.* a triangular form, point to the north base to the south, detached from the broad band to the south (Maraldi Sea, &c.), identified as Oudeman Sea: to the north again, resting on the south edge of the N. polar ice-cap lay Schröter Sea: Secchi Continent lay to the west, a warm yellow region, and Herschel I. Continent, of a similar tint, lay to the east of the central Oudeman Sea; the small, bright, roundish Fontana Land was seen well. The definite outline, darkness, and general similarity of Oudeman Sea to the Kaiser Sea, and its extreme unlikeness to the region so named on Green's map, made this a very interesting object. On the 16th the same features were seen in the same way as on the 15th.

1899 March 16, 10^{h} to 11^{h}. The triangular form like the Kaiser Sea, again well seen. The central portion is the darkest. Its E. and W. edges were well defined. The base or S. side of the triangle faded away into invisibility.

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1899 April 16, 8^h, power 330. The features seen were a small, bright, yellow spot at the S. pole of the disc, the broad grey band of seas &c. extending from limb to terminator, the Kaiser Sea near the terminator, the N. polar cap and the dusky Delambre Sea on its southern edge.

1899 April 17; a few minutes after sunset: definition good; powers 330 and 470. That part of the *p* limb which an hour later will be a bright lune is now of a bright warm colour, while the rest of the disc (the great southern band excepted) is of a dull yellow tint. A long grey form lay near the *p* limb; no doubt it was Oudeman Sea. Delambre Sea appeared, as usual, as a grey form resting on the south edge of the N. polar cap, being darkest close to the cap. Fontana Land was not seen.

1899 April 18, 7^h. Oudeman Sea was about midway between the central meridian and the *p* limb. Delambre Sea &c. as on the 17th. At 8^h on the 19th the same features were seen as on the 18th, only a little more westward, *i.e.* nearer the *p* limb.

1899 April 19, 8^h. Oudeman Sea near the *p* limb. Delambre Sea seen.

2.

Note on a Projection Seen on the Terminator.

1899 January 24. Calm, misty, definition good, image of planet quite steady. On every clear night during this opposition of Mars the limb and the terminator were carefully scrutinised for projections, &c. About $9\frac{1}{2}^h$ a small, seemingly round projection was seen on the terminator: it was about as bright as the disc near the terminator and reminded one of a Jovian satellite when in exterior contact. As to diameter, it was perhaps about $0''\cdot5$, and reckoning the position angle from the middle of the outer edge of the N. polar cap it was about 150°, *i.e.* it was far up towards the S. pole of the disc in the *sf* quadrant. It remained visible for about an hour, and was invisible at 11^h and 12^h. This was the one night of really fine definition out of the forty on which the planet was observed.

In the above notes *east* and *west* are used in the ordinary astronomical (not areographical) sense.

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Note on the Constitution of Saturn's "Crape" Ring.
By E. M. Antoniadi.

Some three years ago the idea was suggested by the writer that the phenomena presented by *Saturn's* inner "dark" ring might be explained by assuming the albedo of its particles to be equal, or at any rate comparable to that of the bright rings, in which case the shading marking the projection of this ring on the planet would be merely the shadow cast by that swarm of meteors.*

Before examining the results arrived at by an application of the deductive method to this interpretation, it would be useful to start with a sound notion of the distribution of matter in the "crape" ring. Professor Barnard's observations of the occultation of *Iapetus* in 1889,† and of the physical appearance of the planet in 1894,‡ have shown this ring to be "very thin at its inner edge," and growing "much denser where it joins the bright ring." True, a reversal of these appearances has been often noted with smaller instruments, the "dark" ring showing itself, at the ansæ, brighter towards the globe of *Saturn*. But this effect is evidently of a purely subjective character, the juxtaposition of the bright ring dwarfing to invisibility that part of the "crape" ring lying in its immediate vicinity. Besides, the fact that the "dark" ring is more transparent to the planet's limb towards its inner edge than close to the bright ring is a striking confirmation of its greater rarefaction near *Saturn*.

This point once established, the hypothesis above enunciated leads us to the following conclusions :—

1. Inasmuch as the heliocentric latitude of *Saturn* can attain the value of 2° 30′, the outline of the dusky shadow projected on the globe would not usually be a rigorous continuation of the "nebular" ansæ.

(*a*) Should the Sun be higher above the plane of the ring-

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* *Journal of the British Astronomical Association*, vol. vii. pp. 241, 242.

† *Monthly Notices*, vol. l. January 1890.

‡ *Ibid.* vol. lv. May 1895.